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(54) METHOD, BASE STATION AND USER EQUIPMENT FOR TRANSMITTING PHYSICAL RESOURCE BLOCK AND CHANNEL ESTIMATING

VERFAHREN, BASISSTATION UND BENUTZERVORRICHTUNG ZUR ÜBERTRAGUNG VON SPERREN PHYSIKALISCHER RESSOURCEN UND ZUR KANALMESSUNG

PROCÉDÉ, STATION DE BASE ET INSTALLATION D'ABONNÉ POUR TRANSMETTRE DES BLOCS DE RESSOURCES PHYSIQUES ET UNE ESTIMATION DE VOIE

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(56) References cited:
CN-A- 101 146 317
CN-A- 101 155 194
CN-A- 101 425 989
US-A1- 2008 192 847

- **SAMSUNG: "Discussion on DM-RS for LTE-Advanced", 3GPP DRAFT; R1-094088 DM RS DESIGNS IN LTE-A, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, no. Miyazaki; 20091012, 12 October 2009 (2009-10-12), XP050388565, [retrieved on 2009-10-05]**
- **RESEARCH IN MOTION ET AL: "Downlink DM-RS Design Considerations for LTE-A", 3GPP DRAFT; R1-094106(RIM-DL_DM-RS), 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, no. Miyazaki; 20091012, 12 October 2009 (2009-10-12), XP050388579, [retrieved on 2009-10-06]**
- **MEHMET KEMAL OZDEMIR ET AL: "Channel estimation for wireless ofdm systems", IEEE COMMUNICATIONS SURVEYS, IEEE, NEW YORK, NY, US, vol. 9, no. 2, 1 April 2007 (2007-04-01), pages 18-48, XP011381247, ISSN: 1553-877X, DOI: 10.1109/COMST.2007.382406**

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- **HUAWEI: "DMRS discussion for rank 5-8", 3GPP DRAFT; R1-100246 DMRS DISCUSSION FOR RANK 5~8, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG1, no. Valencia, Spain; 20100118, 12 January 2010 (2010-01-12), XP050417932, [retrieved on 2010-01-12]**
- **HUAWEI: "DMRS PRB bundling discussion", 3GPP DRAFT; R1-101952 DMRS PRB BUNDLING DISCUSSION, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG1, no. Beijing, china; 20100412, 6 April 2010 (2010-04-06), XP050419294, [retrieved on 2010-04-06]**

Description

FIELD OF THE INVENTION

[0001] Embodiments of the present invention relate to the field of communication technologies and, in particular, to a method, a base station and a user equipment for transmitting physical resource blocks and estimating channels.

BACKGROUND OF THE INVENTION

[0002] The multi-antenna technology can fully utilize space resources of signals to meet the requirement for a higher peak rate without increasing the bandwidth. The main process may be described as follows: A serial data stream at the transmitter undergoes necessary space-time processing to form multiple information sub-streams, and the information sub-streams are transmitted by multiple antennas, and recovered to the data stream at the receiver by using the detection technology. An important prerequisite for a multi-antenna system to obtain a high data transmission rate is that CSI (channel state information, channel state information) is known. In practice, however, the CSI is usually unknown. Therefore, accurate channel estimation is a key technology for ensuring transmission quality in a multi-antenna system.

[0003] At present, channel estimation is classified into blind estimation and training-sequence-based estimation. In training-sequence-based channel estimation, the transmitter inserts a certain number of reference signals into data packets, and the receiver estimates channel coefficients for the position of the known reference signals, obtains channel coefficients for the position of the data by using the channel estimation algorithm and performs data balancing and decoding. The number, position, and adopted sequence of the reference signals all affect channel estimation performance.

[0004] When the channel frequency selectivity is low and the channel is relatively flat, multiple PRBs (Physical Resource Block, physical resource block) are bundled, that is, PRB bundling (physical resource block bundling channel estimation) is used to improve the channel estimation precision.

[0005] In the prior art, when multiple PRBs are bundled for channel estimation, the position and number of reference signals remain the same as when a single PRB is used for channel estimation, causing redundancy and uneven density of the reference signals and affecting the data transmission rate.

[0006] SAMSUNG: "Discussion on DM-RS for LTE-Advanced", 3GPP DRAFT; R1-094088 DM RS DESIGNS IN LTE-A discusses RB bundling for higher rank (see Introduction).

[0007] RESEARCH IN MOTION ET AL: "Downlink DM-RS Design Considerations for LTE-A", 3GPP DRAFT; R1-094106 (RIM-DL_DM-RS), discusses, with more attention on DM-RS design for high-order MIMO, different DM-RS design schemes (see Introduction).

[0008] RESEARCH IN MOTION ET AL: "Channel estimation for wireless ofdm systems", IEEE COMMUNICATIONS SURVEYS, IEEE, NEW YORK, NY, US, vol.9, no.2, 1 April 2007, pages 18-48, ISSN: 1553-877X, DOI: 10.1109/COMST.2007.382406, presents an extensive overview of channel estimation techniques employed in OFDM systems (see Abstract).

SUMMARY OF THE INVENTION

[0009] The invention is defined by the appended claims 1-10. The embodiments that do not fall under the scope of the claims have to be interpreted as examples useful for understanding the invention. Embodiments of the present invention provide a method, a base station and a user equipment for transmitting physical resource blocks and estimating channels, which implement adaptive adjustment of a reference signal structure based on the number of bundled PRBs and improve the system performance.

[0010] An embodiment of the present invention provides a method for transmitting physical resource blocks, including:

scheduling, by a base station, M contiguous physical resource blocks (PRBs) for a user equipment, and configuring reference signal patterns of all sub-carriers in the M PRBs, where a method for configuring the reference signal patterns includes:

allocating (X-1)M+1 demodulation reference signal subcarriers for M PRBs in a frequency domain, and based on a boundary of every two PRBs, configuring only one demodulation reference signal subcarrier within a range of (-N, N] subcarriers in the boundary of every two PRBs, where a centre of the range of (-N, N] is the boundary of every two PRBs, and where the locations of remaining (X-2)M+2 demodulation reference signal subcarriers in each of the M contiguous PRBs are the same as the locations of first demodulation reference signal patterns in a frequency domain;
where X indicates number of demodulation reference signal subcarriers included in a reference signal pattern

of all sub-carriers in a given orthogonal frequency division multiplexing, OFDM, symbol in a single PRB when the base station allocates the single PRB to the user equipment for channel estimation; M is a positive integer greater than 1; N is a positive integer greater than 1 and smaller than or equal to 12/(X+1); the demodulation reference signal subcarrier refers to a subcarrier carrying demodulation reference signals; the first demodulation reference signal pattern refers to a demodulation reference signal pattern used when the base station allocates the single PRB to the user equipment for channel estimation; and
transmitting the configured M PRBs to the user equipment, so that the user equipment performs joint channel estimation according to the configured M PRBs.

[0011] An embodiment of the present invention provides another method for transmitting PRBs, including:

scheduling, by a base station, two contiguous physical resource blocks (PRBs) for a user equipment, and configuring reference signal patterns of all sub-carriers in the two PRBs, where a method for configuring the reference signal patterns includes:

allocating five demodulation reference signal subcarriers for the two PRBs in a frequency domain, and based on a boundary of the two PRBs, configuring only one demodulation reference signal subcarrier within a range of (-2, 2] subcarriers in the boundary of the two PRBs, where a centre of the range of (-2, 2] is the boundary of every two PRBs, and where locations of the remaining four demodulation reference signal subcarriers in each of the two contiguous PRBs are the same as locations of first demodulation reference signal patterns in a frequency domain;
where the demodulation reference signal subcarrier refers to a subcarrier carrying demodulation reference signals; the first demodulation reference signal pattern refers to a demodulation reference signal pattern used when the base station allocates a single PRB to the user equipment for channel estimation; and
transmitting the two configured PRBs to the user equipment, so that the user equipment performs joint channel estimation according to the two configured PRBs.

[0012] An embodiment of the present invention provides another method for transmitting PRBs, including:

scheduling, by a base station, three contiguous physical resource blocks (PRBs) for a user equipment, and configuring reference signal patterns of all sub-carriers in the three PRBs, where a method for configuring the reference signal patterns includes:

allocating seven demodulation reference signal subcarriers for the three PRBs in a frequency domain, and based on a boundary of every two PRBs out of the three PRBs, configuring only one demodulation reference signal subcarrier within a range of (-2, 2] subcarriers in the boundary of every two PRBs, where a centre of the range of (-2, 2] is the boundary of every two PRBs, and where locations of the remaining five demodulation reference signal subcarriers in each of the three contiguous PRBs are the same as locations of demodulation reference signal subcarriers in three contiguous first demodulation reference signal patterns in a frequency domain;
where the demodulation reference signal subcarrier refers to a subcarrier carrying demodulation reference signals; the first demodulation reference signal pattern refers to a demodulation reference signal pattern used when the base station allocates a single PRB to the user equipment for channel estimation; and
transmitting the three configured PRBs to the user equipment, so that the user equipment performs joint channel estimation according to the three configured PRBs.

[0013] An embodiment of the invention provides a method for estimating channels, including:

receiving, by a user equipment, the M contiguous physical resource blocks (PRBs) sent by a base station for joint channel estimation, where the M PRBs include (X-1)M+1 demodulation reference signal subcarriers, and based on a boundary of every two PRBs, only one demodulation reference signal subcarrier is within a range of (-N, N] subcarriers in the boundary of every two PRBs, where a centre of the range of (-N, N] is the boundary of every two PRBs, and locations of the remaining (X-2)M+2 demodulation reference signal subcarriers in each of the M contiguous PRBs are the same as locations of first demodulation reference signal patterns in a frequency domain;
where X indicates number of demodulation reference signal subcarriers included in a reference signal pattern of all sub-carriers in a given orthogonal frequency division multiplexing, OFDM, symbol in a single PRB when the base station allocates the single PRB to the user equipment for channel estimation; M is a positive integer greater than 1; N is a positive integer greater than 1 and smaller than or equal to 12/(X+1); the demodulation reference signal

subcarrier refers to a subcarrier carrying demodulation reference signals; the first demodulation reference signal pattern refers to a demodulation reference signal pattern used when the base station allocates the single PRB to the user equipment for channel estimation;

obtaining, by the user equipment, received signal values of the demodulation reference signal from the demodulation reference signal subcarrier for the M PRBs, and based on the received signal values, estimating channel coefficients for the position of the demodulation reference signal; and

obtaining channel coefficients for the position of data in the M PRBs according to the channel coefficients for the position of the demodulation reference signal and a relative position relationship between the demodulation reference signal and the data.

[0014] An embodiment of the present invention provides a base station, including:

a configuring unit, configured to schedule M contiguous physical resource blocks (PRBs) for a user equipment and configure reference signal patterns of all sub-carriers in the M PRBs according to a manner, where the manner includes:

allocating (X-1)M+1 demodulation reference signal subcarriers for the M PRBs in a frequency domain, and based on a boundary of every two PRBs, configuring only one demodulation reference signal subcarrier within a range of (-N, N] subcarriers in the boundary of every two PRBs, where a centre of the range of (-N, N] is the boundary of every two PRBs, and where locations of the remaining (X-2)M+2 demodulation reference signal subcarriers in each of the M contiguous PRBs are the same as locations of first demodulation reference signal patterns in a frequency domain;

where X indicates number of demodulation reference signal subcarriers included in a reference signal pattern of all sub-carriers in a given orthogonal frequency division multiplexing, OFDM, symbol in a single PRB when the base station allocates the single PRB to the user equipment for channel estimation; M is a positive integer greater than 1; N is a positive integer greater than 1 and smaller than or equal to 12/(X+1); the demodulation reference signal subcarrier refers to a subcarrier carrying demodulation reference signals; the first demodulation reference signal pattern refers to a demodulation reference signal pattern used when the base station allocates the single PRB to the user equipment for channel estimation; and

a transmitting unit, configured to transmit the configured M PRBs to the user equipment, so that the user equipment performs joint channel estimation according to the configured M PRBs.

[0015] An embodiment of the present invention provides a user equipment, including:

a receiving unit, configured to receive the M contiguous physical resource blocks (PRBs) sent by a base station for joint channel estimation, where the M PRBs include (X-1)M+1 demodulation reference signal subcarriers, and based on a boundary of every two PRBs, only one demodulation reference signal subcarrier is within a range of (-N, N] subcarriers in the boundary of every two PRBs, where a centre of the range of (-N, N] is the boundary of every two PRBs, and locations of the remaining (X-2)M+2 demodulation reference signal subcarriers in each of the M contiguous PRBs are the same as locations of first demodulation reference signal patterns in a frequency domain;

where X indicates number of demodulation reference signal subcarriers included in a reference signal pattern of all sub-carriers in a given orthogonal frequency division multiplexing, OFDM, symbol in a single PRB when the base station allocates the single PRB to the user equipment for channel estimation; M is a positive integer greater than 1; N is a positive integer greater than 1 and smaller than or equal to 12/(X+1); the demodulation reference signal subcarrier refers to a subcarrier carrying demodulation reference signals; the first demodulation reference signal pattern refers to a demodulation reference signal pattern used when the base station allocates the single PRB to the user equipment for channel estimation; and

a channel estimating unit, configured to obtain received signal values of the demodulation reference signal from the demodulation reference signal subcarrier from the M PRBs received by the receiving unit, estimate channel coefficients for the position of the demodulation reference signal according to the received signal values, and obtain channel coefficients for the position of data in the M PRBs according to the channel coefficients for the position of the demodulation reference signal and a relative position relationship between the demodulation reference signal and the data.

[0016] According to embodiments of the present invention, when multiple PRBs are scheduled for joint channel estimation, the reference signal configuration mode may be adjusted properly to improve the service data transmission efficiency without changing the channel estimation accuracy. This saves reference signal overhead and increases data transmission rate. Moreover, when different numbers of PRBs are used for joint channel estimation, the reference signal

overhead and the reference signal pattern change adaptively to optimize the data transmission rate. Thereby, the problem that performance is restricted due to the unchanged reference signal structure when multiple PRBs are used for joint channel estimation is effectively solved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

FIG. 1 is a flowchart of a method for transmitting physical resource blocks according to an embodiment of the present invention;
FIG. 2 is a schematic diagram of the reference signal pattern in a single PRB in the prior art;
FIG. 3 is a schematic diagram of the reference signal pattern in a PRB bundling scenario according to an embodiment of the present invention;
FIG. 4 is a schematic diagram of the reference signal pattern in another PRB bundling scenario according to an embodiment of the present invention;
FIG. 5 is a schematic diagram of the reference signal pattern in another PRB bundling scenario according to an embodiment of the present invention;
FIG. 6 is a flowchart of a method for a user equipment to perform channel estimation according to an embodiment of the present invention;
FIG. 7 is a schematic structural diagram of a base station according to an embodiment of the present invention; and
FIG. 8 is a schematic structural diagram of a user equipment according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0018] In order to make the objectives, technical solutions, and advantages of the present invention more comprehensible, the technical solutions according to embodiments of the present invention are clearly and completely described in the following with reference to the accompanying drawings. Apparently, the embodiments in the following description are merely a part rather than all of the embodiments of the present invention. Based on embodiments of the present invention, all other embodiments obtained by persons skilled in the art without making any creative effort shall fall within the protection scope of the present invention.

[0019] As shown in FIG. 1, an embodiment of the present invention provides a method for transmitting physical resource blocks, including:

Step 101: A base station schedules M physical resource blocks (PRBs) for a user equipment and configures reference signal patterns for the M PRBs. The method for configuring the reference signal patterns includes:

allocating (X-1)M+1 demodulation reference signal subcarriers for M PRBs in a frequency domain, and based on a boundary of every two PRBs, configuring only one demodulation reference signal subcarrier within the range of (-N, N] subcarriers in the border of every two PRBs, where locations of the rest (X-2)M+2 demodulation reference signal subcarriers keep consistent with the locations of demodulation reference signal subcarriers in the M contiguous first demodulation reference signal patterns in a frequency domain;
where X indicates the number of demodulation reference signal subcarriers included in the reference signal pattern of the single PRB when the base station allocates a single PRB to the user equipment for channel estimation; M is a positive integer greater than 1; N is a positive integer greater than 1 and smaller than or equal to 12/(X+1); the demodulation reference signal subcarrier refers to a subcarrier carrying demodulation reference signals; the first demodulation reference signal pattern refers to a demodulation reference signal pattern used when the base station allocates a single PRB to the user equipment for channel estimation.

[0020] Further, to improve the channel estimation performance, when performing the above configuration, the only one demodulation reference signal subcarrier within the range of (-N, N] subcarriers in the border of every two PRBs may be kept equidistant from the adjacent upper and lower demodulation reference signal subcarriers.

[0021] Step 102: The base station transmits the configured M PRBs to the user equipment, so that the user equipment performs joint channel estimation according to the configured M PRBs.

[0022] The following describes the method provided in an embodiment of the present invention by using the demodulation reference signal pattern used when the base station allocates a single PRB to the user equipment for channel estimation as the first demodulation reference signal pattern as an example:

[0023] FIG. 2 shows the demodulation reference signal pattern used when a single PRB is used for channel estimation in existing LTE-A (Long Term Evolution-Advanced, long term evolution-advanced) systems. The demodulation reference

signal pattern includes 14*12 REs (resource element, resource element). The area filled with oblique lines represents CRSs (Common reference signal, common reference signals), and the areas with gray shadow represent different DMRSs (Dedicated demodulation reference signal, dedicated demodulation reference signals, hereinafter referred to as demodulation reference signals for simplicity). The demodulation reference signal subcarrier refers to a subcarrier carrying demodulation reference signals in a frequency domain.

[0024] FIG. 3 shows a reference signal pattern configured by using the method provided in an embodiment of the present invention when the values of M, N, and X in the above embodiment are set to 2, 2, and 3 respectively. The area filled with oblique lines represents CRSs (Common reference signal, common reference signals), and the areas with gray shadow represent different DMRSs (Dedicated demodulation reference signal, dedicated demodulation reference signals). Only one demodulation reference signal subcarrier exists within the range of (-N, N] subcarriers in the border of the PRBs. When this demodulation reference signal subcarrier is equidistant from the adjacent upper and lower demodulation reference signal subcarriers, better channel estimation performance can be achieved.

[0025] FIG. 4 shows a reference signal pattern configured by using the method provided in an embodiment of the present invention when the values of M, N, and X are set to 3, 2, and 3 respectively. The area filled with oblique lines represents CRSs, and the areas with gray shadow represent different DMRSs. Only one demodulation reference signal subcarrier exists within the range of (-N, N] subcarriers in the border of the PRBs. When this demodulation reference signal subcarrier is equidistant from the adjacent upper and lower demodulation reference signal subcarriers, better channel estimation performance can be achieved.

[0026] Similarly, the reference signal configuration mode used when M is set to a greater value can be inferred according to the above method, and will not be described here any further.

[0027] Table 1 lists percentage of reference signal overhead reduction when different numbers of PRBs are allocated for joint channel estimation according to this embodiment.

Table 1 Percentage of reference signal overhead reduction

Number of PRBs	2 PRB	3 PRB	4 PRB	5 PRB
Percentage of reference signal overhead reduction	17%	22%	25%	27%

[0028] According to the method provided in an embodiment of the present invention, when multiple PRBs are scheduled for joint channel estimation, the configuration modes of reference signal patterns may be properly adjusted to improve the service data transmission efficiency without changing the channel estimation precision. This saves reference signal overhead and optimizes data transmission rate. Moreover, when different numbers of PRBs are used for joint channel estimation, the reference signal overhead and the reference signal pattern change adaptively to optimize the data transmission rate. Thereby, the problem that performance is restricted due to the unchanged reference signal structure when multiple PRBs are used for joint channel estimation is effectively solved.

[0029] An embodiment of the present invention provides another method for transmitting physical resource blocks, including:

evenly distributing a reference signal structure in the bundled M PRBs, and setting the start position of a reference signal frequency domain to S, the frequency domain interval to L, and the position of the demodulation reference signal subcarrier to m to obtain $m = n*L + S$, $n \in \{0,1,...M*3\}$. FIG. 5 shows a new reference signal structure when S is set to 2 and L is set to 6. For joint channel estimation based on two PRBs, the reference signal structure occupies only four subcarriers. Compared with the first demodulation reference signal pattern where six subcarriers are occupied, this reference signal structure greatly reduces the overhead and improves the throughput.

[0030] An embodiment of the present invention provides a method for a user equipment to perform channel estimation, which corresponds to the method for a base station to configure reference signals illustrated in FIG. 1. As shown in FIG. 6, the method includes:

Step 601: The user equipment receives the M PRBs sent by a base station for joint channel estimation.

[0031] The M PRBs include (X-1)M+1 demodulation reference signal subcarriers, and based on a boundary of every two PRBs, only one demodulation reference signal subcarrier is configured within the range of (-N, N] subcarriers in the border of every two PRBs, and the locations of the rest (X-2)M+2 demodulation reference signal subcarriers keep consistent with the locations of demodulation reference signal subcarriers in the M contiguous first demodulation reference signal patterns in a frequency domain.

[0032] Where X indicates the number of demodulation reference signal subcarriers included in the reference signal

pattern of a single PRB when the base station allocates the single PRB to the user equipment for channel estimation; M is a positive integer greater than 1; N is a positive integer greater than 1 and smaller than or equal to 12/(X+1); the demodulation reference signal subcarrier refers to a subcarrier carrying demodulation reference signals; the first demodulation reference signal pattern refers to a demodulation reference signal pattern used when the base station allocates a single PRB to the user equipment for channel estimation.

[0033] Step 602: The user equipment obtains received signal values of the demodulation reference signal from the M PRBs and estimates channel coefficients for the position of the demodulation reference signal according to the received signal values of the demodulation reference signal.

[0034] The received signal values refer to signal values of the demodulation reference signal in the M PRBs received by the user equipment. The method for estimating channel coefficients for the position of the demodulation reference signal according to the received signal values of the demodulation reference signal can be performed according to the prior art. The method includes estimating channel coefficients for the position of the demodulation reference signal according to the signal values of the demodulation reference signal in the M PRBs sent by the base station and the received signal values of the demodulation reference signal obtained from the M PRBs by the user equipment.

[0035] For example, the above estimation algorithm may be LS (least square, least square).

[0036] Step 603: The user equipment obtains channel coefficients for the position of the data in the M PRBs according to the channel coefficients for the position of the demodulation reference signal and a relative position relationship between the demodulation reference signal and data in the demodulation reference signal patterns of the M PRBs.

[0037] Specifically, the channel coefficients for the above position of the reference signal are interpolated using a certain interpolation algorithm such as linear interpolation or MMSE (minimum mean square error, minimum mean square error) to obtain the channel coefficients for the position of the data in the M PRBs.

[0038] According to the method provided in this embodiment, the user equipment may use multiple PRBs for channel estimation and adapt to flexible configuration of the reference signal patterns of the base station. This configuration optimizes the data transmission rate and effectively solves the problem that performance is restricted due to the unchanged reference signal structure when multiple PRBs are used for joint channel estimation.

[0039] Persons skilled in the art may understand that all or part of the steps in the above embodiments may be completed by a computer program instructing relevant hardware. The program may be stored in a computer readable storage medium such as a ROM/RAM, a magnetic disk, or an optical disk.

[0040] FIG. 7 is a schematic structural diagram of a base station according to an embodiment of the present invention. The base station implements the method provided in the embodiment illustrated in FIG. 1. The base station includes a configuring unit 701 and a transmitting unit 702.

[0041] The configuring unit 701 is configured to schedule M PRBs for a user equipment and configure reference signal patterns for the M PRBs according to a first manner. The first manner includes:

> allocating (X-1)M+1 demodulation reference signal subcarriers for M PRBs in a frequency domain, and based on a boundary of every two PRBs, configuring only one demodulation reference signal subcarrier within the range of (-N, N] subcarriers in the border of every two PRBs, where the locations of the rest (X-2)M+2 demodulation reference signal subcarriers keep consistent with the locations of demodulation reference signal subcarriers in the M contiguous first demodulation reference signal patterns in a frequency domain;
> where X indicates the number of demodulation reference signal subcarriers included in the reference signal pattern of the single PRB when the base station allocates a single PRB to the user equipment for channel estimation; M is a positive integer greater than 1; N is a positive integer greater than 1 and smaller than or equal to 12/(X+1); the demodulation reference signal subcarrier refers to a subcarrier carrying demodulation reference signals; the first demodulation reference signal pattern refers to a demodulation reference signal pattern used when the base station allocates a single PRB to the user equipment for channel estimation.

[0042] The transmitting unit 702 is configured to transmit the M PRBs configured by the configuring unit 701 to the user equipment, so that the user equipment performs joint channel estimation according to the configured M PRBs.

[0043] For the interactions between the base station units and the user equipment and the specific implementation methods of the unit functions, reference may be made to the descriptions in the method embodiments.

[0044] According to this embodiment, when multiple PRBs are used for joint channel estimation, the base station may reduce the reference signal overhead and adjust the reference signal pattern to improve the service data transmission efficiency without changing the channel estimation precision. Moreover, when different numbers of PRBs are used for joint channel estimation, the reference signal overhead and the reference signal pattern will change adaptively to optimize the data transmission rate.

[0045] FIG. 8 is a schematic structural diagram of a user equipment according to an embodiment of the present invention. The user equipment implements the method provided in the embodiment illustrated in FIG. 6. The user equipment includes a receiving unit 801 and a channel estimating unit 802.

[0046] The receiving unit 801 is configured to receive the M PRBs sent by a base station for joint channel estimation, where the M PRBs include (X-1)M+1 demodulation reference signal subcarriers, and based on a boundary of every two PRBs, only one demodulation reference signal subcarrier is within the range of (-N, N] subcarriers in the border of every two PRBs, and the locations of the rest (X-2)M+2 demodulation reference signal subcarriers keep consistent with the locations of demodulation reference signal subcarriers in the M contiguous first demodulation reference signal patterns in a frequency domain;
where X indicates the number of demodulation reference signal subcarriers included in the reference signal pattern of a single PRB when the base station allocates the single PRB to the user equipment for channel estimation; M is a positive integer greater than 1; N is a positive integer greater than 1 and smaller than or equal to 12/(X+1); the demodulation reference signal subcarrier refers to a subcarrier carrying demodulation reference signals; the first demodulation reference signal pattern refers to a demodulation reference signal pattern used when the base station allocates a single PRB to the user equipment for channel estimation.

[0047] For example, M, the number of PRBs used for joint channel estimation received by the receiving unit 801 from the base station, may be equal to 2 or 3, N is equal to 2, and X is equal to 3.

[0048] The channel estimating unit 802 is configured to obtain received signal values of the demodulation reference signal from the demodulation reference signal subcarrier from the M PRBs received by the receiving unit 801, estimate channel coefficients for the position of the demodulation reference signal according to the received signal values of demodulation reference signal, and obtain the channel coefficients for the position of the data in the M PRBs according to the channel coefficients for the position of the demodulation reference signal and a relative position relationship between the demodulation reference signal and data in the demodulation reference signal patterns of the M PRBs.

[0049] For the specific estimation method of the channel estimating unit 802, reference may be made to the method described in step 602 and step 603 of the embodiment illustrated in FIG. 6.

[0050] For the interactions between the user equipment units and the base station and the specific implementation methods of the unit functions, reference may be made to the descriptions in the method embodiments of the present invention.

[0051] According to this embodiment, the user equipment may use multiple PRBs for joint channel estimation and adapt to flexible configuration of the reference signal patterns of the base station. This configuration optimizes the data transmission rate and effectively solves the problem that performance is restricted due to an unchanged reference signal structure when multiple PRBs are used for joint channel estimation.

[0052] It should be specially noted that all or part of the above units can be integrated in a chip. In addition, function units in embodiments of the present invention may be integrated into a processing module, or each of the units may exist alone physically, or two or more units may be integrated into a module. The integrated module may be implemented in a form of hardware, or may be implemented in form of a software functional module. When the integrated module is implemented in form of a software function module and sold or used as an independent product, the module may be stored in a computer readable storage medium. The storage medium may be a read-only memory, a magnetic disk, or an optical disk. The invention is defined by the appended claims 1-10.

Claims

1. A method for transmitting physical resource blocks, comprising:

scheduling, by a base station, M contiguous physical resource blocks, PRBs, for a user equipment and configuring reference signal patterns of all sub-carriers in the M PRBs, wherein a method for configuring the reference signal patterns includes:

allocating (X-1)M+1 demodulation reference signal subcarriers for the M PRBs in a frequency domain, and based on a boundary of every two PRBs, configuring only one demodulation reference signal subcarrier within a range of (-N, N] subcarriers in the boundary of every two PRBs, wherein a centre of the range of (-N, N] is the boundary of every two PRBs, and wherein locations of the remaining (X-2)M+2 demodulation reference signal subcarriers in each of the M contiguous PRBs are the same as locations of first demodulation reference signal patterns in a frequency domain;
where X indicates the number of demodulation reference signal subcarriers included in a reference signal pattern of all sub-carriers in a given orthogonal frequency division multiplexing, OFDM, symbol in a single PRB when the base station allocates the single PRB to the user equipment for channel estimation; M is a positive integer greater than 1; N is a positive integer greater than 1 and smaller than or equal to 12/(X+1); the demodulation reference signal subcarrier refers to a subcarrier carrying the demodulation reference signals; the first demodulation reference signal pattern refers to a demodulation reference signal pattern

used when the base station allocates the single PRB to the user equipment for channel estimation; and transmitting the configured M PRBs to the user equipment, so that the user equipment performs joint channel estimation according to the configured M PRBs.

2. The method according to claim 1, wherein:

M is equal to 2 or 3; N is equal to 2; and X is equal to 3.

3. The method according to claim 1 or 2, wherein the only one demodulation reference signal subcarrier configured within the range of (-N, N] subcarriers in the boundary of the every two PRBs is equidistant from two closest demodulation reference signal subcarriers on an OFDM grid on a same OFDM.

4. A method for estimating channels, comprising:

receiving, by a user equipment, M contiguous physical resource blocks, PRBs, sent by a base station for joint channel estimation, where the M PRBs include (X-1)M+1 demodulation reference signal subcarriers, and based on a boundary of every two PRBs, only one demodulation reference signal subcarrier is within a range of (-N, N] subcarriers in the boundary of every two PRBs, wherein a centre of the range of (-N, N] is the boundary of every two PRBs, and locations of remaining (X-2)M+2 demodulation reference signal subcarriers in each of the M contiguous PRBs are the same as locations of first demodulation reference signal patterns in a frequency domain;
where X indicates number of demodulation reference signal subcarriers included in a reference signal pattern of all sub-carriers in a given orthogonal frequency division multiplexing, OFDM, symbol in a single PRB when the base station allocates the single PRB to the user equipment for channel estimation; M is a positive integer greater than 1; N is a positive integer greater than 1 and smaller than or equal to 12/(X+1); the demodulation reference signal subcarrier refers to a subcarrier carrying demodulation reference signals; the first demodulation reference signal pattern refers to a demodulation reference signal pattern used when the base station allocates the single PRB to the user equipment for channel estimation;
obtaining, by the user equipment, received signal values of the demodulation reference signal from the demodulation reference signal subcarrier for the M PRBs, and according to the received signal values, estimating channel coefficients for position of the demodulation reference signal; and
obtaining channel coefficients for position of data in the M PRBs according to the channel coefficients for the position of the demodulation reference signal and a relative position relationship between the demodulation reference signal and the data.

5. The method according to claim 4, wherein:

M is equal to 2 or 3; N is equal to 2; and X is equal to 3.

6. The method according to claim 4 or 5, wherein the only one demodulation reference signal subcarrier configured within the range of (-N, N] subcarriers in the boundary of every two PRBs is equidistant from two closest demodulation reference signal subcarriers on an OFDM grid on a same OFDM.

7. A base station, comprising:

a configuring unit, configured to schedule M contiguous physical resource blocks, PRBs, for a user equipment and configure reference signal patterns of all sub-carriers in the M PRBs according to a manner, wherein the manner comprises:

allocating (X-1)M+1 demodulation reference signal subcarriers for the M PRBs in a frequency domain, and based on a boundary of every two PRBs, configuring only one demodulation reference signal subcarrier within a range of (-N, N] subcarriers in the boundary of every two PRBs, wherein a centre of the range of (-N, N] is the boundary of every two PRBs, and wherein locations of the remaining (X-2)M+2 demodulation reference signal subcarriers in each of the M contiguous PRBs are the same as locations of first demodulation reference signal patterns in a frequency domain;
where X indicates the number of demodulation reference signal subcarriers included in a reference signal pattern of all sub-carriers in a given orthogonal frequency division multiplexing, OFDM, symbol in a single PRB when the base station allocates the single PRB to the user equipment for channel estimation; M is a

positive integer greater than 1; N is a positive integer greater than 1 and smaller than or equal to 12/(X+1); the demodulation reference signal subcarrier refers to a subcarrier carrying demodulation reference signals; the first demodulation reference signal pattern refers to a demodulation reference signal pattern used when the base station allocates the single PRB to the user equipment for channel estimation; and

a transmitting unit, configured to transmit the configured M PRBs to the user equipment, so that the user equipment performs joint channel estimation according to the configured M PRBs.

8. A base station according to claim 7, wherein N is set to 2 and X is set to 3 according to the manner; and the configuring unit is configured to schedule two or three PRBs for the user equipment and configure reference signal patterns for the two or three PRBs according to the manner.

9. A user equipment, comprising:

a receiving unit, configured to receive M contiguous physical resource blocks, PRBs, sent by a base station for joint channel estimation, wherein the M PRBs comprise (X-1)M+1 demodulation reference signal subcarriers, and based on a boundary of every two PRBs, only one demodulation reference signal subcarrier is within range of (-N, N] subcarriers in the boundary of every two PRBs, wherein a centre of the range of (-N, N] is the boundary of every two PRBs, and locations of remaining (X-2)M+2 demodulation reference signal subcarriers in each of the M contiguous PRBs are the same as locations of first demodulation reference signal patterns in a frequency domain;

where X indicates number of demodulation reference signal subcarriers included in a reference signal pattern of all sub-carriers in a given orthogonal frequency division multiplexing, OFDM, symbol in a single PRB when the base station allocates the single PRB to the user equipment for channel estimation; M is a positive integer greater than 1; N is a positive integer greater than 1 and smaller than or equal to 12/(X+1); the demodulation reference signal subcarrier refers to a subcarrier carrying demodulation reference signals; the first demodulation reference signal pattern refers to a demodulation reference signal pattern used when the base station allocates the single PRB to the user equipment for channel estimation; and

a channel estimating unit, configured to obtain received signal values of the demodulation reference signal from the demodulation reference signal subcarrier from the M PRBs received by the receiving unit, estimate channel coefficients for the position of the demodulation reference signal according to the received signal values of the demodulation reference signal, and obtain channel coefficients for the position of data in the M PRBs according to the channel coefficients for the position of the demodulation reference signal and a relative position relationship between the demodulation reference signal and the data.

10. The user equipment according to claim 9, wherein the number M of the PRBs used for joint channel estimation received by the receiving unit from the base station is equal to 2 or 3; N is equal to 2; and X is equal to 3.

Patentansprüche

1. Verfahren zum Übertragen physischer Ressourcenblöcke, umfassend:

zeitliches Planen, durch eine Basisstation, von M benachbarten physischen Ressourcenblöcken, PRBs, für ein Benutzer-Equipment und Konfigurieren von Referenzsignalmustern aller Unterträger in den M PRBs, wobei ein Verfahren zum Konfigurieren der Referenzsignalmuster beinhaltet:

Zuweisen von (X-1)M+1 Demodulationsreferenzsignal-Unterträgern für die M PRBs in einer Frequenzdomäne und, basierend auf einer Grenze von jeweils zwei PRBs, Konfigurieren nur eines Demodulationsreferenzsignal-Unterträgers innerhalb eines Bereichs von (-N, N] Unterträgern in der Grenze von jeweils zwei PRBs, wobei ein Mittelpunkt des Bereichs von (-N, N] die Grenze von jeweils zwei PRBs ist und wobei die Orte der übrigen (X-2)M+2 Demodulationsreferenzsignal-Unterträger in jedem der M benachbarten PRBs dieselben wie die Orte der ersten Demodulationsreferenzsignalmuster in einer Frequenzdomäne sind;

wobei X die Anzahl der Demodulationsreferenzsignal-Unterträger angibt, die in einem Referenzsignalmuster aller Unterträger in einem gegebenen Symbol des orthogonalen Frequenzmultiplexing ("Orthogonal Frequency Division Multiplexing", OFDM) in einem einzelnen PRB enthalten sind, wenn die Basisstation den einzelnen PRB dem Benutzer-Equipment für eine Kanalschätzung zuweist; M eine positive ganze Zahl größer als 1 ist; N eine positive ganze Zahl größer als 1 und kleiner oder gleich 12/(X+1) ist; der Demodulationsreferenzsignal-Unterträger einen Unterträger bezeichnet, der die Demodulationsreferenzsignale

trägt; das erste Demodulationsreferenzsignalmuster ein Demodulationsreferenzsignalmuster bezeichnet, das verwendet wird, wenn die Basisstation den einzelnen PRB dem Benutzer-Equipment für eine Kanalschätzung zuweist; und
Übertragen der konfigurierten M PRBs an das Benutzer-Equipment, so dass das Benutzer-Equipment eine gemeinsame Kanalschätzung gemäß den konfigurierten M PRBs durchführt.

2. Verfahren gemäß Anspruch 1, wobei:

M gleich 2 oder 3 ist; N gleich 2 ist; und X gleich 3 ist.

3. Verfahren gemäß Anspruch 1 oder 2, wobei der einzige Demodulationsreferenzsignal-Unterträger, der innerhalb des Bereichs von (-N, N] Unterträgern in der Grenze der jeweils zwei PRBs konfiguriert wird, von zwei nächstgelegenen Demodulationsreferenzsignal-Unterträgern auf einem OFDM-Raster auf demselben OFDM äquidistant ist.

4. Verfahren zum Schätzen von Kanälen, umfassend:

Empfangen, durch ein Benutzer-Equipment, von M benachbarten physischen Ressourcenblöcken, PRBs, die von einer Basisstation zur gemeinsamen Kanalschätzung gesendet wurden, wobei die M PRBs (X-1)M+1 Demodulationsreferenzsignal-Unterträger beinhalten, und, basierend auf einer Grenze von jeweils zwei PRBs, nur ein Demodulationsreferenzsignal-Unterträger sich innerhalb eines Bereichs von (-N, N] Unterträgern in der Grenze von jeweils zwei PRBs befindet, wobei ein Mittelpunkt des Bereichs von (-N, N] die Grenze von jeweils zwei PRBs ist und die Orte der übrigen (X-2)M+2 Demodulationsreferenzsignal-Unterträger in jedem der M benachbarten PRBs dieselben wie die Orte der ersten Demodulationsreferenzsignalmuster in einer Frequenzdomäne sind;
wobei X die Anzahl der Demodulationsreferenzsignal-Unterträger angibt, die in einem Referenzsignalmuster aller Unterträger in einem gegebenen Symbol des orthogonalen Frequenzmultiplexing (Orthogonal Frequency Division Multiplexing, OFDM) in einem einzelnen PRB enthalten sind, wenn die Basisstation den einzelnen PRB dem Benutzer-Equipment für eine Kanalschätzung zuweist; M eine positive ganze Zahl größer als 1 ist; N eine positive ganze Zahl größer als 1 und kleiner oder gleich 12/(X+1) ist; der Demodulationsreferenzsignal-Unterträger einen Unterträger bezeichnet, der Demodulationsreferenzsignale trägt; das erste Demodulationsreferenzsignalmuster ein Demodulationsreferenzsignalmuster bezeichnet, das verwendet wird, wenn die Basisstation den einzelnen PRB dem Benutzer-Equipment für eine Kanalschätzung zuweist;
Gewinnen, durch das Benutzer-Equipment, von Empfangssignalwerten des Demodulationsreferenzsignals von dem Demodulationsreferenzsignal-Unterträger für die M PRBs, und gemäß den Empfangssignalwerten, Schätzen von Kanalkoeffizienten für die Position des Demodulationsreferenzsignals; und
Gewinnen von Kanalkoeffizienten für die Position von Daten in den M PRBs gemäß den Kanalkoeffizienten für die Position des Demodulationsreferenzsignals und einer relativen Positionsbeziehung zwischen dem Demodulationsreferenzsignal und den Daten.

5. Verfahren gemäß Anspruch 4, wobei:

M gleich 2 oder 3 ist; N gleich 2 ist; und X gleich 3 ist.

6. Verfahren gemäß Anspruch 4 oder 5, wobei der einzige Demodulationsreferenzsignal-Unterträger, der innerhalb des Bereichs von (-N, N] Unterträgern in der Grenze der jeweils zwei PRBs konfiguriert wird, von zwei nächstgelegenen Demodulationsreferenzsignal-Unterträgern auf einem OFDM-Raster auf demselben OFDM äquidistant ist.

7. Basisstation, umfassend:

eine Konfiguriereinheit, die dafür ausgelegt ist, M benachbarte physische Ressourcenblöcke, PRBs, für ein Benutzer-Equipment zeitlich zu planen und Referenzsignalmuster aller Unterträger in den M PRBs gemäß einer Vorgehensweise zu konfigurieren, wobei die Vorgehensweise umfasst:

Zuweisen von (X-1)M+1 Demodulationsreferenzsignal-Unterträgern für die M PRBs in einer Frequenzdomäne und, basierend auf einer Grenze von jeweils zwei PRBs, Konfigurieren nur eines Demodulationsreferenzsignal-Unterträgers innerhalb eines Bereichs von (-N, N] Unterträgern in der Grenze von jeweils zwei PRBs, wobei ein Mittelpunkt des Bereichs von (-N, N] die Grenze von jeweils zwei PRBs ist und wobei die Orte der übrigen (X-2)M+2 Demodulationsreferenzsignal-Unterträger in jedem der M benachbarten PRBs

dieselben wie die Orte der ersten Demodulationsreferenzsignalmuster in einer Frequenzdomäne sind; wobei X die Anzahl der Demodulationsreferenzsignal-Unterträger angibt, die in einem Referenzsignalmuster aller Unterträger in einem gegebenen Symbol des orthogonalen Frequenzmultiplexing (Orthogonal Frequency Division Multiplexing, OFDM) in einem einzelnen PRB enthalten sind, wenn die Basisstation den einzelnen PRB dem Benutzer-Equipment für eine Kanalschätzung zuweist; M eine positive ganze Zahl größer als 1 ist; N eine positive ganze Zahl größer als 1 und kleiner oder gleich 12/(X+1) ist; der Demodulationsreferenzsignal-Unterträger einen Unterträger bezeichnet, der Demodulationsreferenzsignale trägt; das erste Demodulationsreferenzsignalmuster ein Demodulationsreferenzsignalmuster bezeichnet, das verwendet wird, wenn die Basisstation den einzelnen PRB dem Benutzer-Equipment für eine Kanalschätzung zuweist; und

eine Sendeeinheit, die dafür ausgelegt ist, die konfigurierten M PRBs an das Benutzer-Equipment zu übertragen, so dass das Benutzer-Equipment eine gemeinsame Kanalschätzung gemäß den konfigurierten M PRBs durchführt.

8. Basisstation gemäß Anspruch 7, wobei gemäß der Vorgehensweise N auf 2 gesetzt und X auf 3 gesetzt ist; und die Konfiguriereinheit dafür ausgelegt ist, zwei oder drei PRBs für das Benutzer-Equipment zeitlich zu planen und Referenzsignalmuster für die zwei oder drei PRBs gemäß der Vorgehensweise zu konfigurieren.

9. Benutzer-Equipment, umfassend:

eine Empfangseinheit, die dafür ausgelegt ist, M benachbarte physische Ressourcenblöcke, PRBs, zu empfangen, die von einer Basisstation für eine gemeinsame Kanalschätzung gesendet wurden, wobei die M PRBs (X-1)M+1 Demodulationsreferenzsignal-Unterträger beinhalten, und, basierend auf einer Grenze von jeweils zwei PRBs, nur ein Demodulationsreferenzsignal-Unterträger sich innerhalb eines Bereichs von (-N, N] Unterträgern in der Grenze von jeweils zwei PRBs befindet, wobei ein Mittelpunkt des Bereichs von (-N, N] die Grenze von jeweils zwei PRBs ist und die Orte der übrigen (X-2)M+2 Demodulationsreferenzsignal-Unterträger in jedem der M benachbarten PRBs dieselben wie die Orte der ersten Demodulationsreferenzsignalmuster in einer Frequenzdomäne sind;
wobei X die Anzahl der Demodulationsreferenzsignal-Unterträger angibt, die in einem Referenzsignalmuster aller Unterträger in einem gegebenen Symbol des orthogonalen Frequenzmultiplexing (Orthogonal Frequency Division Multiplexing, OFDM) in einem einzelnen PRB enthalten sind, wenn die Basisstation den einzelnen PRB dem Benutzer-Equipment für eine Kanalschätzung zuweist; M eine positive ganze Zahl größer als 1 ist; N eine positive ganze Zahl größer als 1 und kleiner oder gleich 12/(X+1) ist; der Demodulationsreferenzsignal-Unterträger einen Unterträger bezeichnet, der Demodulationsreferenzsignale trägt; das erste Demodulationsreferenzsignalmuster ein Demodulationsreferenzsignalmuster bezeichnet, das verwendet wird, wenn die Basisstation den einzelnen PRB dem Benutzer-Equipment für eine Kanalschätzung zuweist; und
eine Kanalschätzeinheit, die dafür ausgelegt ist, Empfangssignalwerte des Demodulationsreferenzsignals von dem Demodulationsreferenzsignal-Unterträger aus den M PRBs zu gewinnen, die durch die Empfangseinheit empfangen wurden, Kanalkoeffizienten für die Position des Demodulationsreferenzsignals gemäß den Empfangssignalwerten des Demodulationsreferenzsignals zu schätzen und Kanalkoeffizienten für die Position von Daten in den M PRBs gemäß den Kanalkoeffizienten für die Position des Demodulationsreferenzsignals und einer relativen Positionsbeziehung zwischen dem Demodulationsreferenzsignal und den Daten zu gewinnen.

10. Benutzer-Equipment gemäß Anspruch 9, wobei die Anzahl M der für eine gemeinsame Kanalschätzung verwendeten PRBs, die durch die Empfangseinheit von der Basisstation empfangen werden, gleich 2 oder 3 ist; N gleich 2 ist; und X gleich 3 ist.

Revendications

1. Procédé permettant de transmettre des blocs de ressources physiques, comprenant les étapes suivantes :

planifier, par une station de base, M blocs de ressources physiques, PRB, contigus pour un équipement utilisateur et configurer des schémas de signal de référence de toutes les sous-porteuses dans les M PRB, un procédé permettant de configurer les schémas de signal de référence comprenant :

attribuer (X-1)M+1 sous-porteuses de signal de référence de démodulation pour les M PRB dans un domaine fréquentiel, et sur la base d'une limite de tous les deux PRB, configurer uniquement une sous-porteuse de

signal de référence de démodulation dans une plage de (-N, N] sous-porteuses dans la limite de tous les deux PRB, un centre de la plage de (-N, N] étant la limite de tous les deux PRB, et des emplacements des (X-2)M+2 sous-porteuses de signal de référence de démodulation restantes dans chacun des M PRB contigus étant les mêmes que des emplacements de premiers schémas de signal de référence de démodulation dans un domaine fréquentiel ;

X indiquant le nombre de sous-porteuses de signal de référence de démodulation incluses dans un schéma de signal de référence de toutes les sous-porteuses dans un symbole de multiplexage par division orthogonale de la fréquence, OFDM, donné dans un PRB unique lorsque la station de base attribue le PRB unique à l'équipement utilisateur pour une estimation de canal ; M étant un nombre entier positif supérieur à 1 ; N étant un nombre entier positif supérieur à 1 et inférieur ou égal à 12/(X+1) ; la sous-porteuse de signal de référence de démodulation désignant une sous-porteuse portant les signaux de référence de démodulation ; le premier schéma de signal de référence de démodulation désignant un schéma de signal de référence de démodulation utilisé lorsque la station de base attribue le PRB unique à l'équipement utilisateur pour une estimation de canal ; et

transmettre les M PRB configurés à l'équipement utilisateur, pour que l'équipement utilisateur exécute une estimation de canal conjoint selon les M PRB configurés.

2. Procédé selon la revendication 1, dans lequel :

M est égal à 2 ou 3 ; N est égal à 2 ; et X est égal à 3.

3. Procédé selon la revendication 1 ou 2, dans lequel la seule sous-porteuse de signal de référence de démodulation configurée dans la plage de (-N, N] sous-porteuses dans la limite des tous les deux PRB est équidistante de deux sous-porteuses de signal de référence de démodulation les plus proches sur une grille OFDM sur un même OFDM.

4. Procédé permettant d'estimer des canaux, comprenant :

recevoir, par un équipement utilisateur, M blocs de ressources physiques, PRB, contigus envoyés par une station de base pour une estimation de canal conjoint, les M PRB comportant (X-1)M+1 sous-porteuses de signal de référence de démodulation, et sur la base d'une limite de tous les deux PRB, une seule sous-porteuse de signal de référence de démodulation est dans une plage de (-N, N] sous-porteuses dans la limite de tous les deux PRB, un centre de la plage de (-N, N] étant la limite de tous les deux PRB, et des emplacements des (X-2)M+2 sous-porteuses de signal de référence de démodulation restantes dans chacun des M PRB contigus étant les mêmes que des emplacements de premiers schémas de signal de référence de démodulation dans un domaine fréquentiel ;

X indiquant un nombre de sous-porteuses de signal de référence de démodulation incluses dans un schéma de signal de référence de toutes les sous-porteuses dans un symbole de multiplexage par division orthogonale de la fréquence, OFDM, donné dans un PRB unique lorsque la station de base attribue le PRB unique à l'équipement utilisateur pour une estimation de canal ; M étant un nombre entier positif supérieur à 1 ; N étant un nombre entier positif supérieur à 1 et inférieur ou égal à 12/(X+1) ; la sous-porteuse de signal de référence de démodulation désignant une sous-porteuse portant des signaux de référence de démodulation ; le premier schéma de signal de référence de démodulation désignant un schéma de signal de référence de démodulation utilisé lorsque la station de base attribue le PRB unique à l'équipement utilisateur pour une estimation de canal ;

obtenir, par l'équipement utilisateur, des valeurs de signal reçues du signal de référence de démodulation à partir de la sous-porteuse de signal de référence de démodulation pour les M PRB, et selon les valeurs de signal reçues, estimer des coefficients de canal pour une position du signal de référence de démodulation ; et obtenir des coefficients de canal pour une position de données dans les M PRB selon les coefficients de canal pour la position du signal de référence de démodulation et une relation de position relative entre le signal de référence de démodulation et les données.

5. Procédé selon la revendication 4, dans lequel :

M est égal à 2 ou 3 ; N est égal à 2; et X est égal à 3.

6. Procédé selon la revendication 4 ou 5, dans lequel la seule sous-porteuse de signal de référence de démodulation configurée dans la plage de (-N, N] sous-porteuses dans la limite de tous les deux PRB est équidistante de deux sous-porteuses de signal de référence de démodulation les plus proches sur une grille OFDM sur un même OFDM.

7. Station de base, comprenant :

une unité de configuration, configurée pour planifier M blocs de ressources physiques, PRB, contigus pour un équipement utilisateur et configurer des schémas de signal de référence de toutes les sous-porteuses dans les M PRB selon une manière, la manière comprenant :

attribuer (X-1)M+1 sous-porteuses de signal de référence de démodulation pour les M PRB dans un domaine fréquentiel, et sur la base d'une limite de tous les deux PRB, configurer uniquement une sous-porteuse de signal de référence de démodulation dans une plage de (-N, N] sous-porteuses dans la limite de tous les deux PRB, un centre de la plage de (-N, N] étant la limite de tous les deux PRB, et des emplacements des (X-2)M+2 sous-porteuses de signal de référence de démodulation restantes dans chacun des M PRB contigus étant les mêmes que des emplacements de premiers schémas de signal de référence de démodulation dans un domaine fréquentiel ;

X indiquant le nombre de sous-porteuses de signal de référence de démodulation incluses dans un schéma de signal de référence de toutes les sous-porteuses dans un symbole de multiplexage par division orthogonale de la fréquence, OFDM, donné dans un PRB unique lorsque la station de base attribue le PRB unique à l'équipement utilisateur pour une estimation de canal ; M étant un nombre entier positif supérieur à 1 ; N étant un nombre entier positif supérieur à 1 et inférieur ou égal à 12/(X+1) ; la sous-porteuse de signal de référence de démodulation désignant une sous-porteuse portant des signaux de référence de démodulation ; le premier schéma de signal de référence de démodulation désignant un schéma de signal de référence de démodulation utilisé lorsque la station de base attribue le PRB unique à l'équipement utilisateur pour une estimation de canal ; et

une unité de transmission, configurée pour transmettre les M PRB configurés à l'équipement utilisateur, pour que l'équipement utilisateur exécute une estimation de canal conjoint selon les M PRB configurés.

8. Station de base selon la revendication 7, dans laquelle N est défini comme étant 2 et X est défini comme étant 3 selon la manière ; et l'unité de configuration est configurée pour planifier deux ou trois PRB pour l'équipement utilisateur et configurer des schémas de signal de référence pour les deux ou trois PRB selon la manière.

9. Equipement utilisateur, comprenant :

une unité de réception, configurée pour recevoir M blocs de ressources physiques, PRB, contigus envoyés par une station de base pour une estimation de canal conjoint, les M PRB comportant (X-1)M+1 sous-porteuses de signal de référence de démodulation, et sur la base d'une limite de tous les deux PRB, une seule sous-porteuse de signal de référence de démodulation est dans une plage de (-N, N] sous-porteuses dans la limite de tous les deux PRB, un centre de la plage de (-N, N] étant la limite de tous les deux PRB, et des emplacements des (X-2)M+2 sous-porteuses de signal de référence de démodulation restantes dans chacun des M PRB contigus étant les mêmes que des emplacements de premiers schémas de signal de référence de démodulation dans un domaine fréquentiel ;

X indiquant un nombre de sous-porteuses de signal de référence de démodulation incluses dans un schéma de signal de référence de toutes les sous-porteuses dans un symbole de multiplexage par division orthogonale de la fréquence, OFDM, donné dans un PRB unique lorsque la station de base attribue le PRB unique à l'équipement utilisateur pour une estimation de canal ; M étant un nombre entier positif supérieur à 1 ; N étant un nombre entier positif supérieur à 1 et inférieur ou égal à 12/(X+1) ; la sous-porteuse de signal de référence de démodulation désignant une sous-porteuse portant des signaux de référence de démodulation ; le premier schéma de signal de référence de démodulation désignant un schéma de signal de référence de démodulation utilisé lorsque la station de base attribue le PRB unique à l'équipement utilisateur pour une estimation de canal ; et une unité d'estimation de canal, configurée pour obtenir des valeurs de signal reçues du signal de référence de démodulation à partir de la sous-porteuse de signal de référence de démodulation à partir des M PRB reçus par l'unité de réception, estimer des coefficients de canal pour la position du signal de référence de démodulation selon les valeurs de signal reçues du signal de référence de démodulation, et obtenir des coefficients de canal pour la position de données dans les M PRB selon les coefficients de canal pour la position du signal de référence de démodulation et une relation de position relative entre le signal de référence de démodulation et les données.

10. Equipement utilisateur selon la revendication 9, dans lequel le nombre M des PRB utilisés pour une estimation de canal conjoint reçue par l'unité de réception à partir de la station de base est égal à 2 ou 3 ; N est égal à 2 ; et X est égal à 3.

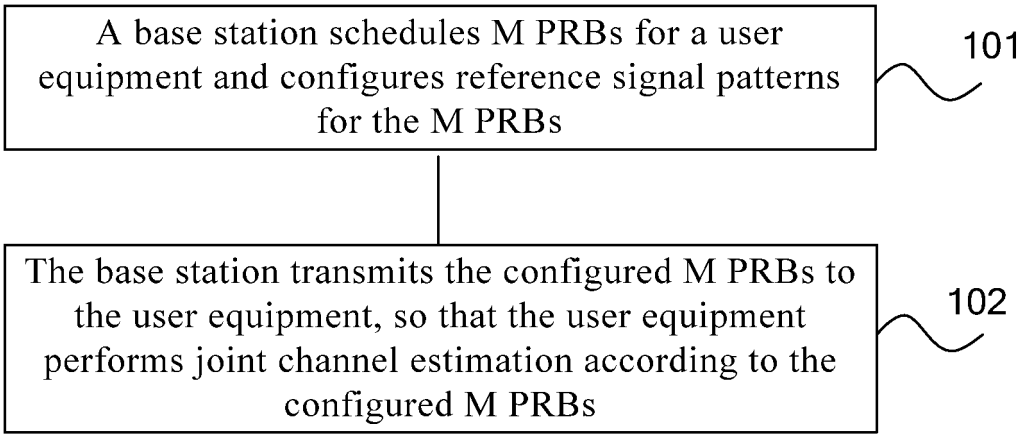

A base station schedules M PRBs for a user equipment and configures reference signal patterns for the M PRBs
101
The base station transmits the configured M PRBs to the user equipment, so that the user equipment performs joint channel estimation according to the configured M PRBs
102

FIG. 1

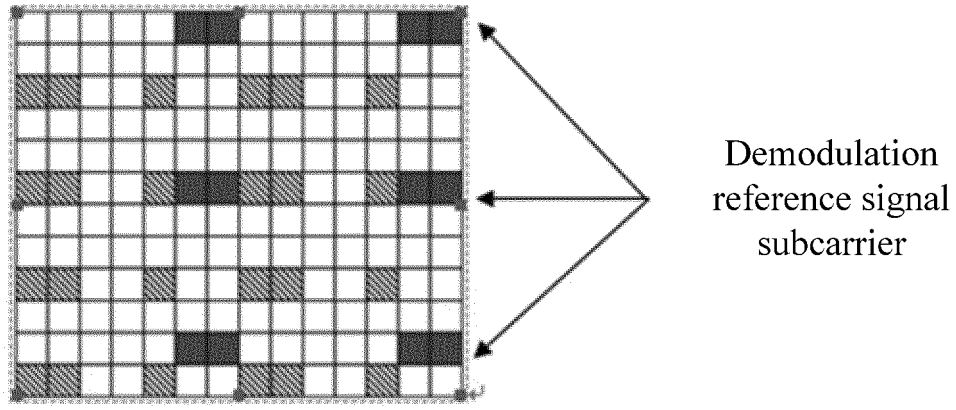

Demodulation reference signal subcarrier

FIG. 2

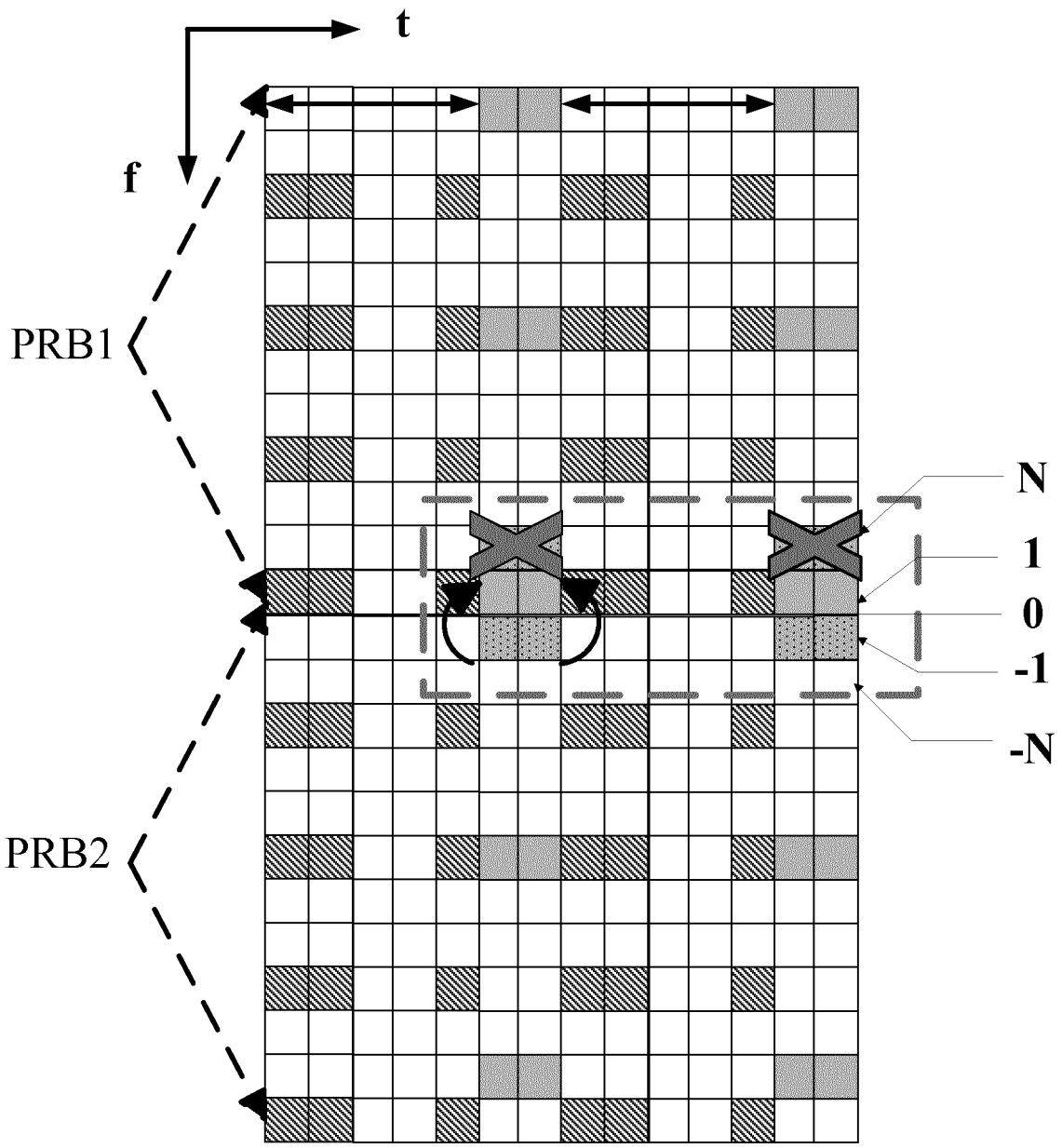


FIG. 3

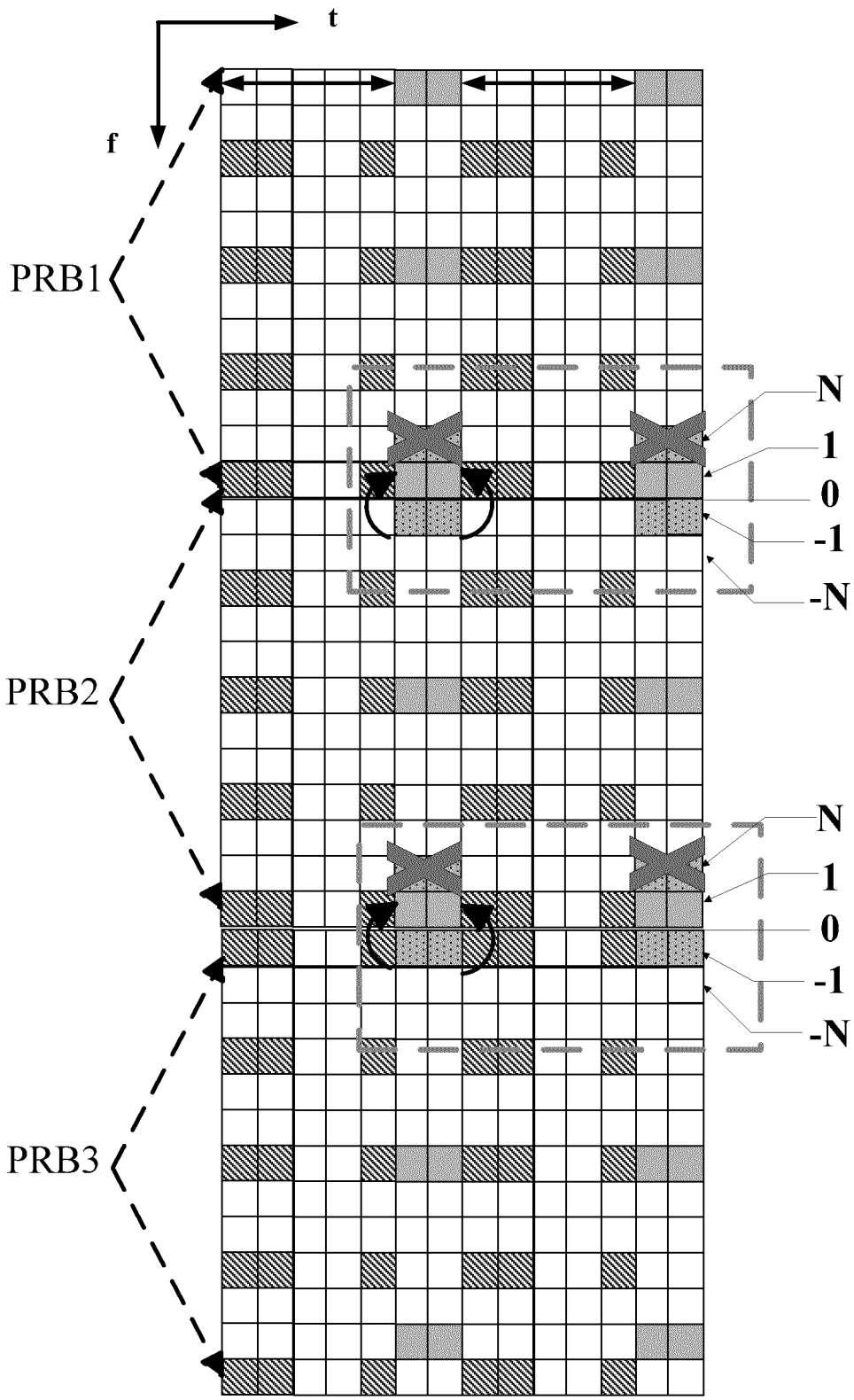


FIG. 4

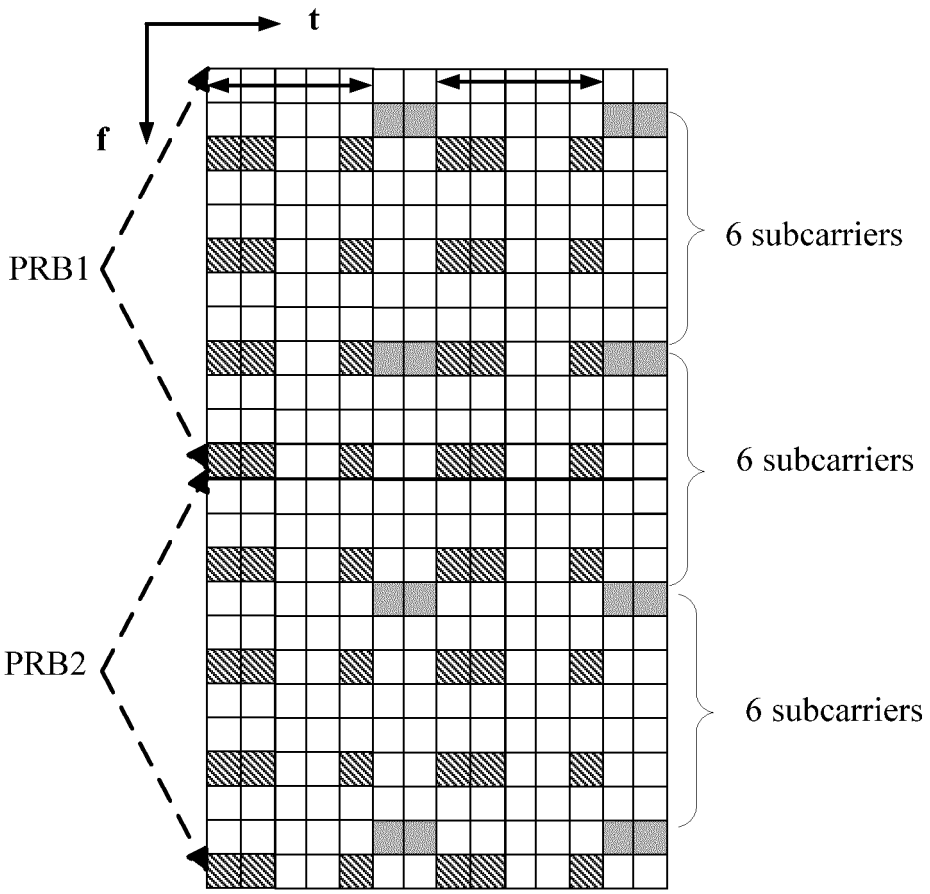


FIG 5

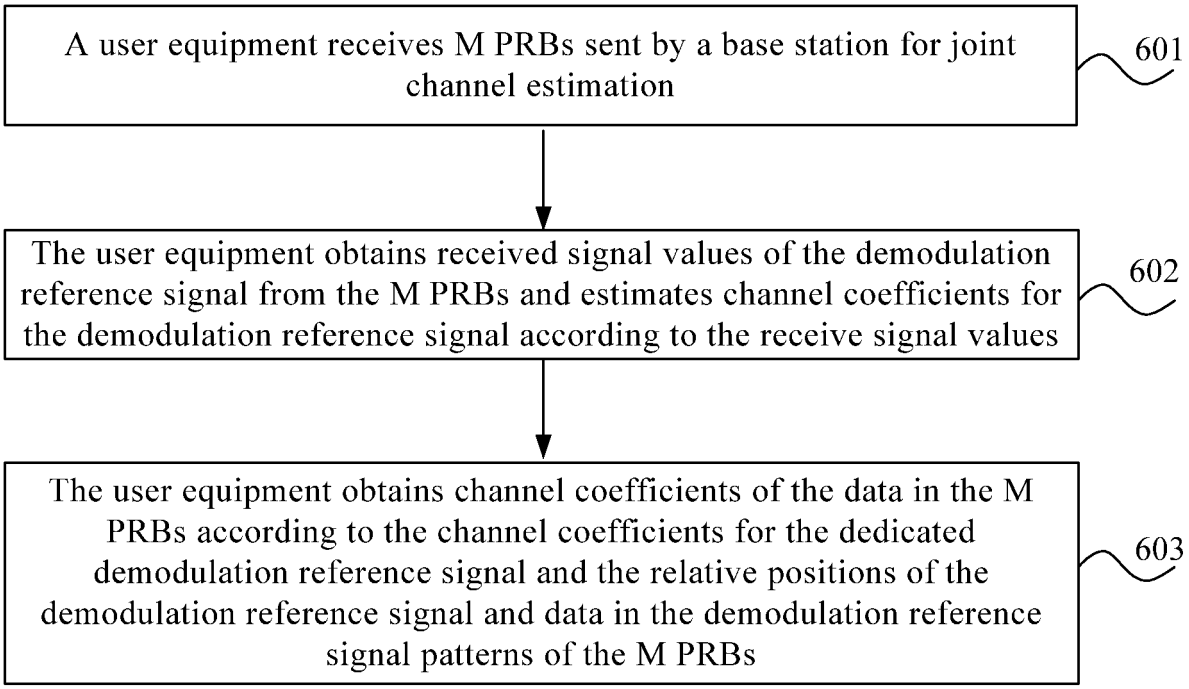


FIG 6

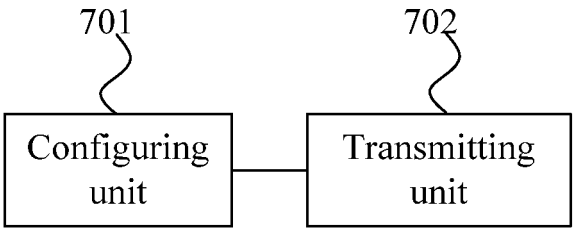


FIG 7

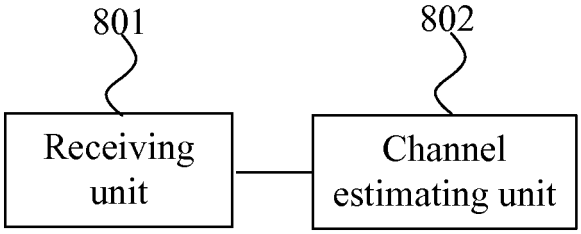


FIG 8

REFERENCES CITED IN THE DESCRIPTION

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Non-patent literature cited in the description

- **SAMSUNG.** Discussion on DM-RS for LTE-Advanced. *3GPP DRAFT* **[0006]**
- **MOTION et al.** Downlink DM-RS Design Considerations for LTE-A. *3GPP DRAFT* **[0007]**
- Channel estimation for wireless ofdm systems. **MOTION et al.** IEEE COMMUNICATIONS SURVEYS. IEEE, 01 April 2007, vol. 9, 18-48 **[0008]**